

AUTOMATIC ADAPTIVE DIMENSIONING FOR CAD SOFTWARE

Field of the Invention

This invention relates to computer software. In particular, this invention relates to an improvement in computer aided design (CAD) software.

5 Background of the Invention

There are many types of computer aided design (CAD) software which assist in architectural design and drafting. Such software is widely used, as it considerably simplifies the task of drafting plans to scale with such annotations as are required for the needs of the user.

10 One of the advantages of CAD software is a feature whereby an object can have dimension annotations associated with the object, including dimension lines, extension lines, symbols of termination (e.g. arrowheads, architectural ticks) and dimension text, created automatically. Thus, the dimension can be automatically
15 annotation of the drawing, which had previously had been a very time consuming process.

Some CAD programs allow manual associative dimensioning, by which a dimension annotation can be manually associated with an object, and thereafter if the object is moved the dimension annotation adjusts automatically with the object. This
20 also facilitates the annotation of drawings, however it requires that the user manually attach the dimension to the object in order for changes in the object to be reflected in the associated dimension annotation. Furthermore, if the object is broken, for example if another object is interposed in or superposed onto an intermediate point of the
25 existing object, the associative dimensioning cannot accommodate the new object and new dimensions, so new dimension annotations corresponding to the new object must be manually added and new associations must be established between the existing dimension annotation and the remaining portions of the existing object. This is a time consuming process, particularly during the modification stages of CAD drafting.

For example, adding a window to an existing wall in a CAD drawing requires that the window be inserted at the intended position, that the existing dimension annotations be deleted and that new extension lines, dimension lines, termination symbols and dimension text be created to reflect the new segmentation of the object and/or the addition of any new object (or the removal of an existing object).

It would accordingly be advantageous if dimension annotations were created automatically as objects are created, and automatically associated with the objects as they are created. It would further be advantageous if dimension annotations would change automatically to accommodate any change to the existing objects, such as a new object inserted into a selected position relative to the existing objects or the deletion of an object from a group of objects.

Summary of the Invention

The present invention overcomes these disadvantages by providing automatic adaptive dimensioning in a CAD software program. According to the invention, dimension annotations are created by the CAD program automatically as an object is drawn and automatically associated with the target object. Thereafter, changing the length of the target object automatically changes the associated dimension annotation, or alternatively, changing the associated dimension annotation automatically changes the length of the target object. Further, changing the dimension annotation associated with an adjacent object automatically changes the position of the target object.

Moreover, when another object is inserted into an intermediate position of an existing object, the automatic adaptive dimensioning feature of the invention automatically creates dimension annotations corresponding to the position of the new object relative to the existing object; likewise, the new object can be automatically positioned in relation to the existing object by specifying interposition dimensions or segment lengths in the existing dimension annotations. Thereafter, any changes to the lengths or relative positions of the objects will automatically change the associated dimension annotations, and any changes made to the associated dimension annotations will automatically change the lengths and/or relative positions of the objects.

Incorporating the automatic adaptive dimensioning feature of the invention into a CAD program accordingly substantially decreases the production time of architectural drawings. The commensurate savings in labour, particularly in the input, documentation and modification stages of drawing preparation, provides a
5 considerable advantage over conventional CAD drawing programs.

These and other features of the invention will be apparent from the detailed description which follows.

The present invention thus provides a method of annotating a computer aided design drawing, comprising the steps of a. setting parameters of dimension
10 annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, b. creating a target object by selecting a length of the target object; and c. automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target
15 target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

The present invention further provides a computer program product for use
20 with a computer, the computer program product comprising a computer usable medium having computer readable program code means embodied in said medium for annotating a computer aided design drawing, said computer program product having computer readable program code means for setting parameters of dimension
25 annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, computer readable program code means for creating a target object by selecting a length of the target object; and computer readable program code means for automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object
30 such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension

annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

5 The present invention further provides a program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for annotating a computer aided design drawing, said method steps comprising: a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, b. creating a target object by selecting a length of the target
10 object; and c. automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically
15 adjusted to correspond to the modification of the length or relative position of the target object.

A further aspect of the invention includes the step of, in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both,
20 automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

Brief Description of the Drawings

In drawings which illustrate by way of example only a preferred embodiment of the invention,

25 Figure 1 is a diagrammatic illustration of objects and associated dimension annotations in a conventional CAD drawing,

Figure 2 is a diagrammatic illustration of an object and associated dimension annotations in a CAD drawing using the method of the invention,

Figure 3 is a diagrammatic illustration of the drawing of Figure 2 after inserting a new object,

Figure 4 is a diagrammatic illustration of the drawing of Figure 3 after inserting a new object,

5 Figure 5 is a diagrammatic illustration of the drawing of Figure 4 after inserting a new object,

Figure 6 is a diagrammatic illustration of the drawing of Figure 5 after inserting a new object,

10 Figure 7 is a diagrammatic illustration of the drawing of Figure 6 after inserting a new object,

Figure 8 is a diagrammatic illustration of the drawing of Figure 7 after inserting a new object,

Figure 9 is a diagrammatic illustration of the drawing of Figure 8 after inserting a new object,

15 Figure 10 is a diagrammatic illustration of the drawing of Figure 9 after moving an existing object, and

Figure 11 is a diagrammatic illustration of the drawing of Figure 10 after deleting an object.

Detailed Description of the Invention

20 Figure 1 illustrates an architectural drawing by way of example. In a conventional CAD drawing program, line objects representing walls 10 and a windows 12 which are drawn or inserted in the CAD environment. Dimension text 20 specifying the lengths and relative positions of the objects 10, 12 are entered by the user, and in some CAD programs may be thereafter manually associated with each
25 respective object 10, 12, so that a change in the length of the object is automatically reflected in the associated dimension text 20. Extension lines 22 are positioned or picked (selected) by the user for the desired dimension text, and dimension lines 24

and termination symbols 26 such as architectural ticks are either manually created by the user, or generated based on user-defined settings, based on the selected positions of the extension lines 22.

According to the invention, the dimension annotations are automatically created and associated with the respective objects to which they relate, and thereafter these dimension annotations are adaptive. Thus, the interposition or superposition of a new object in or onto an existing object automatically results in new extension lines 22 at the extremities of the new object, parsing of the existing dimension line 24 into segments with selected termination symbols 26, and the repositioning and
recalculation of dimension text to accommodate the new object.

In use, to create a horizontal or vertical dimension associated with an object 10, 12, the object dimension text 20 can be selected by clicking, picking or otherwise specifying first and second points representing the ends of the object 10 or 12. In the case of multiple dimension strings, the locations of the dimension lines 24 (for example baseline strings or aligned strings) are also specified by the initial user settings, as are extension lines 22 and dimension text 20, with the selected termination symbols 26, which are thereafter generated automatically by the adaptive dimensioning feature of the invention based on the coordinate positions selected for the object. This feature of the invention also automatically trims or extends the dimensions annotations in response to a change in the size or position of the associated target object.

Thereafter, modifications to the existing objects 10, 12, may be made in two ways:

1. By modifying the length of the target object 8 itself and/or moving the target object to a new position relative to other objects. In this situation the associated dimension annotations automatically change to adapt to the modification of the associated object's dimension and/or position, moving extension lines, arrowheads or other termination symbols, and dimension text as necessary to accommodate the modification.

2. By changing dimension text to specify a new length for the target object 8, and/or changing the dimension text of an adjacent object to reposition the target object. In this case, the length of the object whose associated dimension text has been modified changes to correspond to the modified dimension. If the length of an adjacent object is changed, the target object is repositioned to remain adjacent to the adjacent object.

Specifics of the extension lines 22, alignment of dimension lines 24 (e.g. as aligned or baseline), type of termination symbols (e.g. architectural ticks), size and placement of dimension text 20, and any other desired parameters, are selected as setup parameters by the user before commencing drawing. The CAD drawing will automatically adaptively associate dimension annotations having the predefined parameters with the respective objects as they are inserted, deleted or modified.

Thus, in the example shown as a series of drawing steps in Figures 2 to 11, a target object 8, in Figure 2 being a wall 10a, is inserted into a new CAD drawing by selecting points 11a and 11b. Dimension annotations are automatically created by the method and computer program of the invention, by creating extension lines 22a aligned with the extremities of the target object 10a, creating a dimension line 24a with termination symbols 26a at its ends and creating dimension text 20a adjacent to the dimension line 24a (or as otherwise specified by the user in the setup parameters).

In Figure 3 the target object 8 is a new exterior wall 10b, added to the drawing of Figure 2 by selecting point 11c. Again dimension annotations are automatically created for the target object by aligning extension lines 22b with the extremities of the target object 8, creating a dimension line 24b with termination symbols 26b at its ends and creating dimension text 20b adjacent to the dimension line 24b. When a new target object 8 is created, for example another exterior wall 10c, by selecting point 11d, as shown in Figure 4, in addition to automatically creating dimension annotations for the new exterior wall 10c, the position of the dimension annotations for the previous object are automatically shifted to accommodate the new target object 8.

Figures 5, 6 and 7 each add a further target object 8, in each case an exterior wall 10d, 10e and 10f, by the selection of points 11e, 11f and 11a, respectively, to delimit the exterior of the structure, and in each case dimension annotations are automatically created for each target object 8 as the target object 8 is inserted, by creating extension lines 22d, 22e, 22f aligned with the extremities of the walls 10d, 10e and 10f, creating dimension lines 24d, 24e, 24f with termination symbols 26d, 26e, 26f at their respective ends and creating dimension text 20d, 20e, 20f adjacent to the respective dimension lines 24d, 24e, 24f.

In Figure 8 a target object 8 comprising a partition wall 10g is added to the drawing of Figure 7 by selecting points 11h and 11j. In this case the adaptive feature of the invention automatically creates extension lines 22g at the appropriate points on the existing dimension lines 24a, 24f, parses the existing dimension lines 24a, 24f into segments 24g, and deletes the existing dimension text 20a, 20f and replaces it with new dimension text 20g relating to the newly created dimension line segments 24g. Similarly, when a target object 8 comprising a window 12 is added in Figure 9, the adaptive dimensioning feature of the invention automatically creates a new dimension line 24h (as specified by the user in the setup parameters) at the window 12 having an on-center extension line 22h with associated dimension text 20h and termination symbols 26h.

In Figure 10, the target object 8 is wall 10c adjacent to the wall 10d with the window 12. Wall 10c is repositioned by dragging the wall 10c to a new position from the previous position (shown in phantom lines). The automatic adaptive dimensioning feature of the invention automatically moves all associated extension lines 22b, 22d to align with the repositioned wall 10c, and replaces the existing dimension text 20b, 22d of the resized walls 10b, 10d with new dimension text 20b, 20d reflecting the new position of the wall 10c relative to adjacent objects. The lengths of walls 10b, 10d adjacent to the target object 8 (wall 10c) automatically adjust to the new position of wall 10c.

To complete the drawing, in Figure 11 the partition wall 10g (shown in phantom lines) has been deleted. The automatic adaptive dimensioning feature of the

invention deletes the extension lines 22 previously associated with the partition 10g to reconstitute the original dimension lines 24f, deletes the dimension text 20g of the parsed dimension line segments 24g, and restores the original dimension text 24f (from Figure 7).

5 Thus, the invention provides an automatic adaptive dimensioning feature in a CAD program which automatically creates and associates dimension annotations as an object is inserted into a drawing, and modifies the dimension annotations as an object is added, deleted or modified in the drawing. The invention thus provides a method of creating and modifying a CAD drawing which considerably simplifies the
10 CAD documentation process.

The automatic adaptive dimensioning feature of the invention can be programmed into CAD software, or can be created as an independent program loaded as a "plug-in" for existing CAD software.

15 A preferred embodiment of the present invention having been thus described by way of example, variations and modifications will be apparent to those skilled in the art. The invention includes all such variations and modifications as fall within the scope of the appended claims.